PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-119093
(43)Date of publication of application : 27.04.2001

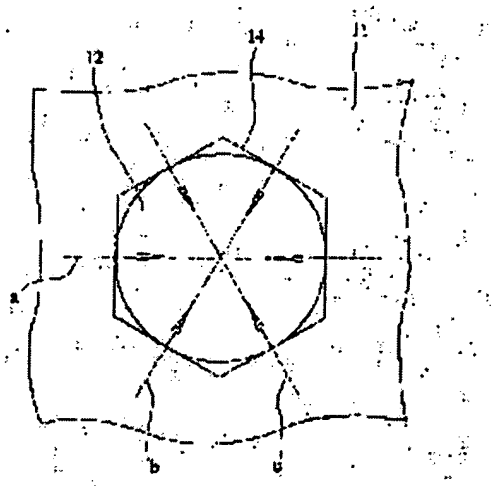
(51)Int.Cl. H01S 5/022
H01L 31/0232
H01L 33/00

(21)Application number : 11-296197
(22)Date of filing : 19.10.1999

(71)Applicant : OKI ELECTRIC IND CO LTD
(72)Inventor : SHIBUYA YOSHIKI
MINEO NAOYUKI

(54) OPTICAL MODULE

(57)Abstract:
PROBLEM TO BE SOLVED: To realize enhancement in positional accuracy of joining a chip to a substrate in an optical module.
SOLUTION: In an optical module, an electrode pad of a chip is joined to an electrode pad of a substrate via a bump. A planar shape of an electrode pad 14 formed on a substrate or chip 11 is regular hexagon. A spherical bump 12 is connected solderless to this electrode pad, so as to come to contact internally with a side of the regular hexagon. A scope of expanding the bump at fusing is regulated with respect to directions perpendicular to two sides which are confronted in the electrode pad, namely a direction, b direction and c direction. Thus, the range of expanding the bump is regulated from the three directions, whereby since a regulative direction is increased as compared with the conventional squared electrode pad, positional accuracy of joining the chip to the substrate is increased.



11:基板またはチップ 12:球状バンプ 14:電極パッド

第1発明の作用効果の説明図

LEGAL STATUS

[Date of request for examination] 06.10.2006

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The optical module characterized by making the flat-surface configuration of the both sides of said chip and a substrate, or one of electrode pads into the shape of a forward hexagon in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump.
[Claim 2] The optical module characterized by two sides making the flat-surface configuration of the both sides of said chip and a substrate, or one of electrode pads each configuration of three forward hexagons which it comes to connect mutually in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump.
[Claim 3] The optical module characterized by considering as the configuration where two or more round shapes connected linearly the flat-surface configuration of the both sides of said chip and a substrate, or one of electrode pads, in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump.
[Claim 4] The optical module characterized by making the flat-surface configuration of the both sides of said chip and a substrate, or one of electrode pads into the configuration which the sides which two or more forward hexagons be the configurations arranged linearly, and counter mutually [each forward hexagon] connected in the optical module to which the electrode pad of a chip and the electrode pad of a substrate be joined by the bump.
[Claim 5] The optical module characterized by preparing the electrode pad of said chip directly under the barrier layer of said chip in an optical module given in any 1 term of claims 1-4.
[Claim 6] In the optical module to which the electrode pad and the electrode pad of a substrate which were prepared in the pad forming face of a chip were joined by the bump the electrode pad of said chip The 1st electrode pad prepared in the location of the top-most vertices of the rectangle region formed by said pad forming face, While consisting of the 2nd electrode pad prepared in the location of the intersection of the diagonal line of this rectangle region, the flat-surface configuration of said 1st and 2nd electrode pad being a forward hexagon-like, respectively and each of said 1st electrode pad carrying out orientation to the same direction The optical module characterized by carrying out orientation to the sense to which said 2nd electrode pad rotated only the include angle of 30 degrees from the sense of said 1st electrode pad.
[Claim 7] In the optical module to which the electrode pad and the electrode pad of a substrate which were prepared in the pad forming face of a chip were joined by the bump the electrode pad of said chip The 1st electrode pad prepared in the location of the top-most vertices of the rectangle region formed by said pad forming face, It consists of the 2nd electrode pad prepared in the location of the intersection of the diagonal line of this rectangle region. While the flat-surface configuration of said 1st and 2nd electrode pad is each configuration of three forward hexagons with which it comes to connect two sides mutually, respectively and each of said 1st electrode pad is carrying out orientation to the same direction The optical module characterized by carrying out orientation to the sense to which said 2nd electrode pad rotated only the include angle of 30 degrees from the sense of said 1st electrode pad.
[Claim 8] In the optical module to which the electrode pad and the electrode pad of a substrate which were prepared in the pad forming face of a chip were joined by the bump the electrode pad of said chip The 1st electrode pad prepared in the location of the top-most vertices of the rectangle region formed by said pad forming face, It consists of the 2nd electrode pad prepared in the location of the intersection of the diagonal line of this rectangle region. The flat-surface configuration of said 1st electrode pad It is the optical module characterized by for two sides being each configurations of three forward hexagons which it comes to connect mutually, for three forward hexagons being the configurations arranged linearly, and the flat-surface configuration of said 2nd electrode pad being a configuration which the sides which

counter mutually [each forward hexagon] connected.
[Claim 9] The optical module characterized by making said rectangle region into the field formed so that said 2nd electrode pad might be located directly under the barrier layer of said chip in an optical module given in any 1 term of claims 6-8.
[Claim 10] the optical module with which the flat surface configuration of said chip and the electrode pad of the both sides of a substrate be make into the shape of a forward hexagon , and the sense of the electrode pad of said chip and the sense of the electrode pad of said substrate be characterize by carry out orientation , respectively so that only the include angles of 30 degrees may differ mutually at the time of association in the optical module to which the electrode pad of a chip and the electrode pad of a substrate be joined by the bump .
[Claim 11] The optical module characterized by considering as the configuration where the sides which counter mutually [each forward hexagon] were connected in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump so that two or more forward hexagons may be arranged in the shape of zigzag in the flat surface configuration of the both sides of said chip and a substrate , or one of electrode pads .
[Claim 12] The optical module characterized by making the extension direction of this electrode pad in agreement with the longitudinal direction of said barrier layer in an optical module according to claim 11 while preparing the electrode pad of said chip directly under the barrier layer of said chip.
[Claim 13] The optical module characterized by making the flat-surface configuration of the both sides of said chip and a substrate, or one of electrode pads into the configuration which two or more honeycomb structures which connected six forward hexagons annularly and were acquired connected linearly in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump.
[Claim 14] The optical module characterized by making the array direction of said honeycomb structure in agreement with the longitudinal direction of said barrier layer in an optical module according to claim 13 while preparing the electrode pad of said chip directly under the barrier layer of said chip.
[Claim 15] The optical module characterized by using said chip as a semiconductor laser component, a photo detector, or an electric-field absorption mold light modulation element in an optical module given in any 1 term of claims 1-14.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump.
[0002]
[Description of the Prior Art] Generally, light corpuscle children, such as a laser diode array component of many channels and a photo detector array, are offered as an optical module, where dice bonding is carried out to a substrate. The optical axis of the optical coupling system constituted by the light corpuscle child of such an optical module has desirable no adjusting-izing. Therefore, generally alignment is performed to dice bonding and coincidence.
[0003] For example, according to the conventional technique indicated by reference "the 1995 Institute of Electronics, Information and Communication Engineers synthesis convention C-215", the chip formed as a light corpuscle child is combined by the solder bump to a substrate. If a solder bump becomes more than fixed magnitude with the ratio (aspect ratio) of height to a bump's width of face, the stability by surface tension will come to commit her by the solder bump in the condition of having fused. Self-alignment mounting is performed by using this stability.
[0004] Moreover, the advantage which uses a stripe-like bump is mentioned to the above-mentioned reference. If the diameter of a bump is enlarged in order that a common spherical bump may get bonding strength, a bump's height will also become large and the junction location precision of the height direction will fall. On the other hand, the stripe-like bump says that bump height can be reduced where a plane-of-composition product is secured.
[0005]
[Problem(s) to be Solved by the Invention] However, a stripe-like bump has problems [configuration], such as distortion and a cone. Therefore, a dispersion improvement effect to the extent that it expected is not accepted, but only a result with this insufficient approach is obtained. Therefore, it is expected that it is obtained that a result [use / the usual spherical bump] is more desirable. And since it explains below, improvement in the junction location precision of a chip and a substrate is expectable by devising the configuration of an electrode pad where a spherical bump is stuck by pressure.
[0006] Drawing 15 is a top view with which explanation of a technical problem is presented. As shown in drawing 15 , the square-like electrode pad 10 is formed on the conventional substrate or the chip 11. On this electrode pad 10, the spherical bump 12 is stuck by pressure so that it may be inscribed in the side of the electrode pad 10. A bump 12 will fuse, if a reflow etc. is heat-treated, and she spreads in the electrode pad 10. The breadth range of a bump 12 is restricted in the location of the side of the shape of a straight line of the electrode pad 10. For this reason, the breadth range of x directions and the direction of y in drawing 15 of a bump 12 is regulated. Thus, the usual electrode pad 10 has secured junction location precision by regulating the breadth range of a bump 12 from a 2-way. Therefore, if this regulation direction can be increased, junction location precision will improve.
[0007] In addition, if the configuration of an electrode pad is made circular, the regulation direction mentioned above will increase most. However, since a degree of freedom is completely lost, it becomes the column configuration where the bump configuration when seeing from a side face inclined, and precision will be dropped on reverse.
[0008] Invention concerning this application is made in view of the above-mentioned point, and aims at improvement in the junction location precision of the chip and substrate in an optical module.
[0009]
[Means for Solving the Problem] That is, according to the optical module of invention concerning this

application, in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump, it is characterized by making the flat-surface configuration of the both sides of a chip and a substrate, or one of electrode pads into the shape of a forward hexagon.

[0010] Drawing 1 is a top view with which explanation of the operation effectiveness of the optical module of this 1st invention is presented. As shown in drawing 1 , the forward hexagon-like electrode pad 14 is formed on the substrate or the chip 11. On this electrode pad 14, the spherical bump 12 is stuck by pressure so that it may be inscribed in the side of the electrode pad 14. If this bump 12 heat-treats, she will fuse, and she spreads in the electrode pad 14. At this time, the breadth range of a bump 12 receives regulation from a direction vertical to the side of a forward hexagon. That is, the breadth range of a bump 12 receives regulation to the direction vertical to two sides of a where the electrode pad 14 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c. Thus, according to this invention, an electrode pad is written as the shape of a forward hexagon, and the breadth range of a bump 12 comes to be regulated from three directions. Therefore, the regulation direction increases compared with the electrode pad of the shape of a conventional square, and the junction location precision of a chip and a substrate increases.

[0011] Moreover, according to the optical module of other invention concerning this application, it sets to the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump. It is the configuration where three forward hexagons connected the flat-surface configuration of the both sides of a chip and a substrate, or one of electrode pads, and is characterized by considering as the configuration which one side of the forward hexagon of everything [sides / two] but each forward hexagon connected, respectively.

[0012] Drawing 2 is a top view with which explanation of the operation effectiveness of the optical module of this 2nd invention is presented. As shown in drawing 2 , each electrode pad 16 of a configuration of three forward hexagons with which it comes to connect two sides mutually is formed on the substrate or the chip 11. On this electrode pad 16, three spherical bumps 12 are stuck by pressure. Each bump 12 is stuck by pressure so that it may be inscribed in the side of three forward hexagons which constitute the electrode pad 16, respectively. If each bump 12 heat-treats, she will fuse, and she spreads in the electrode pad 16. The breadth range of this bump 12 receives regulation in the part of the side of the electrode pad 16. That is, the breadth range of a bump 12 receives regulation to the direction vertical to two sides of a where the electrode pad 16 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c.

[0013] Thus, as for the electrode pad of this invention, the breadth range of a bump is regulated from three directions. Therefore, the junction location precision of a chip and a substrate increases compared with the electrode pad of the shape of a conventional square.

[0014] Furthermore, the bump configuration shown in drawing 2 is equivalent to the configuration where the stripe-like bump extended to each of the direction of a, the direction of b, and the direction of c. Therefore, since a plane-of-composition product becomes large and only the part can make a bump's height low, height dispersion of the height direction after junction can be made small.

[0015] Moreover, it is characterized by considering as the configuration where two or more round shapes connected [application / this / pan / to apply] linearly the flat-surface configuration of the both sides of a chip and a substrate, or one of electrode pads in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump according to the optical module of other invention.

[0016] Drawing 3 is a top view with which explanation of the operation effectiveness of the optical module of this 3rd invention is presented. As shown in drawing 3 , the electrode pad 18 of a configuration which two or more round shapes connected linearly is formed on the substrate or the chip 11. On this electrode pad 18, after the spherical bump 12 of a circular number and the same number has arranged linearly, it is stuck by pressure. If each bump 12 heat-treats, she will fuse, and she spreads in the electrode pad 18. The breadth range of this bump 12 receives regulation in the part of the radii of the electrode pad 18.

[0017] According to the above-mentioned electrode pad, since each spherical bump after melting connects mutually, a plane-of-composition product increases. Therefore, by making small each spherical bump's diameter of a bump, where an aspect ratio is kept high, bump height can be made low. Therefore, height dispersion of the height direction after junction can be made small.

[0018] Moreover, as mentioned above, the breadth range of a bump's direction of a field is regulated in the part of the radii of the electrode pad arranged to the circular connection direction. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.

[0019] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad of a chip and the electrode pad of a

substrate were joined by the bump. It is the configuration where two or more forward hexagons arranged linearly the flat-surface configuration of the both sides of a chip and a substrate, or one of electrode pads, and is characterized by considering as the configuration which the sides which counter mutually [each forward hexagon] connected.

[0020] Drawing 4 is a top view with which explanation of the operation effectiveness of the optical module of this 4th invention is presented. As shown in drawing 4 , the electrode pad 20 of a configuration which two or more forward hexagons connected linearly is formed on the substrate or the chip 11. On this electrode pad 20, after the spherical bump 12 of the number of forward hexagons and the same number has arranged linearly, it is stuck by pressure. If each bump 12 heat-treats, she will fuse, and she spreads in the electrode pad 20. The breadth range of this bump 12 receives regulation in the part of the side of the electrode pad 20. That is, the breadth range of a bump 12 receives regulation to the direction vertical to two sides of a where the electrode pad 20 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c.

[0021] According to the above-mentioned electrode pad, since each spherical bump after melting connects mutually, a plane-of-composition product increases. Therefore, by making small each spherical bump's diameter of a bump, where an aspect ratio is kept high, bump height can be made low. Therefore, height dispersion of the height direction after junction can be made small.

[0022] Moreover, since it is the configuration which extends while the configuration of the side which extends in the connection direction of a forward hexagon of the electrode pad 20 bends in the shape of zigzag at the include angle of 60 degrees, the breadth range of a bump 12 receives regulation to the longitudinal direction of the electrode pad 20, and the both directions of the direction of a short hand by this side. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.

[0023] Moreover, in the optical module of each invention mentioned above, it is good preferably to prepare the electrode pad of a chip directly under the barrier layer of a chip.

[0024] Thus, if constituted, the heat generated from the barrier layer of a chip can be efficiently missed to a substrate through an electrode pad. Therefore, the property of a chip is stabilized.

[0025] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad and the electrode pad of a substrate which were prepared in the pad forming face of a chip were joined by the bump. The 1st electrode pad prepared in the location of the top-most vertices of a rectangle region where the electrode pad of a chip was formed by the pad forming face, While consisting of the 2nd electrode pad prepared in the location of the intersection of the diagonal line of this rectangle region, the flat-surface configuration of the 1st and 2nd electrode pad being a forward hexagon-like, respectively and each of the 1st electrode pad carrying out orientation to the same direction It is characterized by carrying out orientation to the sense to which the 2nd electrode pad rotated only the include angle of 30 degrees from the sense of the 1st electrode pad.

[0026] Thus, since the 1st electrode pad is prepared in the location of the four corners of a rectangle region, gap of the hand of cut of a chip is easy to be amended. Moreover, since each 1st electrode pad is a forward hexagon-like, gap of the direction of a flat surface can be made small. Furthermore, the forward hexagon-like 2nd electrode pad is prepared in the location of the intersection of the diagonal line of a rectangle region, and it is made the sense which only the include angle of 30 degrees made rotate the sense of this 2nd electrode pad from the sense of the 1st electrode pad. Therefore, location gap of a chip is amended to a total of six directions.

[0027] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad and the electrode pad of a substrate which were prepared in the pad forming face of a chip were joined by the bump. The 1st electrode pad prepared in the location of the top-most vertices of a rectangle region where the electrode pad of a chip was formed by the pad forming face, It consists of the 2nd electrode pad prepared in the location of the intersection of the diagonal line of this rectangle region. While the flat-surface configuration of the 1st and 2nd electrode pad is each configuration of three forward hexagons with which it comes to connect two sides mutually, respectively and each of the 1st electrode pad is carrying out orientation to the same direction It is characterized by carrying out orientation to the sense to which the 2nd electrode pad rotated only the include angle of 30 degrees from the sense of the 1st electrode pad.

[0028] Thus, since the 1st electrode pad is prepared in the location of the four corners of a rectangle region, gap of the hand of cut of a chip is easy to be amended. Moreover, since it is the configuration where each 1st electrode pad connected three forward hexagons, gap of the direction of a flat surface can be made small. Furthermore, the 2nd electrode pad of a configuration which three forward hexagons connected is prepared in the location of the intersection of the diagonal line of a rectangle region, and it is

made the sense which only the include angle of 30 degrees made rotate the sense of this 2nd electrode pad from the sense of the 1st electrode pad. Therefore, location gap of a chip is amended to a total of six directions. Moreover, since bump height can be made low according to the 1st and 2nd electrode pad, taking a large aspect ratio, dispersion in the height direction also becomes small.

[0029] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad and the electrode pad of a substrate which were prepared in the pad forming face of a chip were joined by the bump. The 1st electrode pad prepared in the location of the top-most vertices of a rectangle region where the electrode pad of a chip was formed by the pad forming face, It consists of the 2nd electrode pad prepared in the location of the intersection of the diagonal line of this rectangle region. The flat-surface configuration of the 1st electrode pad Two sides are each configurations of three forward hexagons which it comes to connect mutually, and the flat-surface configuration of the 2nd electrode pad is characterized by for three forward hexagons being the configurations arranged linearly, and being the configuration which the sides which counter mutually [each forward hexagon] connected.

[0030] Thus, since the 1st electrode pad is prepared in the location of the four corners of a rectangle region, gap of the hand of cut of a chip is easy to be amended. Moreover, since it is the configuration where each 1st electrode pad connected three forward hexagons, gap of the direction of a flat surface can be made small. Furthermore, the 2nd electrode pad of a configuration which three forward hexagons connected linearly is prepared in the location of the intersection of the diagonal line of a rectangle region. Therefore, location gap of a chip becomes small. Moreover, since bump height can be made low according to the 1st and 2nd electrode pad, taking a large aspect ratio, dispersion in the height direction also becomes small.

[0031] Moreover, it is good to make each above-mentioned rectangle region into the field formed so that the 2nd electrode pad might be located directly under the barrier layer of a chip preferably.

[0032] Thus, if constituted, the heat generated from the barrier layer of a chip can be efficiently missed to a substrate through an electrode pad.

[0033] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump. The flat-surface configuration of a chip and the electrode pad of the both sides of a substrate is made into the shape of a forward hexagon, and the sense of the electrode pad of a chip and the sense of the electrode pad of a substrate are characterized by carrying out orientation, respectively so that only the include angles of 30 degrees may differ mutually at the time of association.

[0034] Thus, according to this invention, since the breadth range of a bump receives regulation with a forward hexagon-like electrode pad, the junction location precision of a chip and a substrate becomes high compared with the former. Moreover, since the side of the electrode pad of a substrate and the side of the electrode pad of a chip are not parallel, the force of a hand of cut works by the bump who fused. If two or more electrode pads are in a chip and a substrate, a chip and a substrate will not rotate. The force of this hand of cut is committed effective in self-alignment, and junction location precision is raised further.

[0035] Moreover, according to the optical module of other invention to the pan concerning this application, in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump, it is characterized by consider as the configuration where the sides which counter mutually [each forward hexagon] were connected so that two or more forward hexagons may be arranged in the shape of zigzag in the flat surface configuration of the both sides of a chip and a substrate, or one of electrode pads.

[0036] According to the electrode pad in this invention, since each spherical bump after melting connects mutually, a plane-of-composition product increases. Therefore, by making small each spherical bump's diameter of a bump, where an aspect ratio is kept high, bump height can be made low. Therefore, height dispersion of the height direction after junction can be made small. Moreover, since the electrode pad is made into the zigzag configuration, the breadth range of a bump receives regulation to the longitudinal direction of an electrode pad, and the both directions of the direction of a short hand. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.

[0037] In addition, preferably, while preparing the electrode pad of a chip directly under the barrier layer of a chip, it is good to make the extension direction of this electrode pad in agreement with the longitudinal direction of a barrier layer.

[0038] Thus, if constituted, the heat generated from the barrier layer of a chip can be efficiently missed to a substrate through an electrode pad.

[0039] Moreover, it is characterized by considering as the configuration which two or more honeycomb

structures which connected annularly and were acquired [hexagons / six / forward] in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump in the flat-surface configuration of the both sides of a chip and a substrate or one of electrode pads connected [application / this / pan / to apply] linearly according to the optical module of other invention.
[0040] If such annular honeycomb structure is used, location gap of a hand of cut will be canceled and junction location precision will improve.
[0041] Moreover, preferably, while preparing the electrode pad of a chip directly under the barrier layer of a chip, it is good to make the array direction of honeycomb structure in agreement with the longitudinal direction of a barrier layer.
[0042] Thus, if constituted, the heat generated from the barrier layer of a chip can be efficiently missed to a substrate through an electrode pad.
[0043] In the optical module of this invention, it is good preferably to use the above-mentioned chip as a semiconductor laser component, a photo detector, or an electric-field absorption mold light modulation element.
[0044]
[Embodiment of the Invention] Hereafter, with reference to drawing, it explains per gestalt of implementation of this invention. In addition, drawing shows a configuration, magnitude, and arrangement relation roughly to extent which can understand this invention. Moreover, conditions, ingredients, etc., such as a numeric value indicated below, are only mere examples. Therefore, this invention is not limited to the gestalt of this operation at all.
[0045] [Gestalt of the 1st operation] drawing 5 is drawing showing the 1st configuration of the optical module of the gestalt of operation. As for this optical module, the electrode pad of a chip and the electrode pad of a substrate are joined by the bump. Drawing 5 (A) is the top view showing the pad forming face side of a substrate. Drawing 5 (B) is the top view showing the pad forming face side of a chip. Drawing 5 (C) is the side elevation showing the condition that the chip and the substrate are joined by the bump.
[0046] Silicon, a ceramic, etc. are used for the substrate 22. The wiring pattern 24 and the dice bonding pad (an electrode pad is called hereafter.) 26 are formed in pad forming face 22a of a substrate 22. These wiring pattern 24 and the electrode pad 26 gold-plate on the surface of chrome plating, respectively. The wiring pattern 24 of this example is formed in the shape of a stripe. On a substrate 22, two or more wiring patterns 24 have arranged to parallel mutually. Moreover, the pattern of the electrode pad 26 is made into the shape of a forward hexagon. This electrode pad 26 is connected to the edge of each wiring pattern 24. Orientation of each electrode pad 26 is carried out to the same direction. on this electrode pad 26, the spherical solder bump (the following and a spherical bump -- or a bump is only called.) 28 is stuck by pressure so that it may be inscribed in the side of a forward hexagon.
[0047] Moreover, the chip 30 of this example is constituted as a laser diode array component (semiconductor laser component). The stripe-like barrier layer 32 is made in this chip 30. Two or more barrier layers 32 in a chip 30 are mutually arranged to parallel. The wiring pad (an electrode pad is called hereafter.) 34 of the shape of two or more square is formed in pad forming face 30a of this chip 30. Each electrode pad 34 is arranged directly under the barrier layer 32, respectively. This electrode pad 34 may be made into the shape of a forward hexagon as well as the electrode pad 26 of a substrate 22.
[0048] And the pad forming faces 22a and 30a of a substrate 22 and a chip 30 are made to have countered. In this condition, the location of the electrode pad 26 of a substrate 22 and the location of the electrode pad 34 of a chip 30 suit. And between these electrode pad 26 and 34 is joined by the spherical bump 28. As mentioned above, the spherical bump 28 is first stuck by pressure on the electrode pad 26 of a substrate 22. Then, a chip 30 is laid where the electrode pad 34 is set on a bump 28. In this condition, if it lets these substrates 22 and a chip 30 pass to a reflow tub, a bump 28 will melt and during a substrate 22 and a chip 30 will be joined. In this process, the stability generated by the bump 28 amends the junction location between a substrate 22 and a chip 30. That is, self-alignment is performed.
[0049] With the gestalt of this operation, since the forward hexagon-like electrode pad 26 is used as shown in drawing 5 (A), the breadth range of the bump 28 at the time of melting receives regulation to the direction vertical to two sides of a where the electrode pad 26 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c. Therefore, since the breadth range of a bump 28 will be regulated from three directions and the regulation direction increases compared with the electrode pad of the shape of a conventional square, the junction location precision of a chip 30 and a substrate 22 increases.
[0050] Thus, from a barrier layer 32, if the constituted optical module is operated, while light occurs, heat will occur with the carrier used as light. Since the electrode pad 34 is provided directly under the barrier layer 32 as mentioned above, this heat escapes at good effectiveness to a substrate 22 through the

electrode pad 34, a bump 28, and the electrode pad 26.
[0051] In addition, although the chip 30 was used as the semiconductor laser component with the gestalt of this operation, it is good also not only considering this but the chip 30 as a photo detector or an electric-field absorption mold light modulation element.
[0052] [Gestalt of the 2nd operation] drawing 6 is the top view showing the 2nd configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 2nd operation and the optical module of the gestalt of the 1st operation is in the point of the electrode pad configuration of a substrate, it shows only a substrate and its electrode pad to drawing 6 , and is omitting the graphic display of other configurations.
[0053] The pad forming face 22a side of a substrate 22 is shown in drawing 6 . The wiring pattern 24 and the electrode pad 36 are formed in this pad forming face 22a. The wiring pattern 24 is formed in the shape of a stripe. Moreover, two sides make the pattern of the electrode pad 36 each configuration of three forward hexagons which it comes to connect mutually. Each electrode pad 36 is connected to the edge of the wiring pattern 24, respectively. Moreover, orientation of each electrode pad 36 is carried out to the same direction. On this electrode pad 36, three spherical bumps 28 are stuck by pressure so that it may be inscribed in the side of a forward hexagon.
[0054] Since the electrode pad 36 of the configuration which consists of three forward hexagons is used as shown in drawing 6 , the breadth range of the bump 28 at the time of melting receives regulation to the direction vertical to two sides of a where the electrode pad 36 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c. Therefore, since the breadth range of a bump 28 will be regulated from three directions and the regulation direction increases compared with the electrode pad of the shape of a conventional square, the junction location precision of a chip and a substrate 22 increases.

[0055] Furthermore, a bump's 28 configuration shown in drawing 6 is equivalent to the configuration where the stripe-like bump extended to each of the direction of a, the direction of b, and the direction of c. Therefore, since a plane-of-composition product becomes large and only the part can make a bump's 28 height low, height dispersion of the height direction after junction can be made small.
[0056] In addition, it is suitable also for the electrode pad of a chip to make it the same configuration as the electrode pad 36 of a substrate 22.
[0057] [Gestalt of the 3rd operation] drawing 7 is the top view showing the 3rd configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 3rd operation and the optical module of the gestalt of the 1st operation is in the point of the electrode pad configuration of a substrate, it shows only a substrate and its electrode pad to drawing 7 , and is omitting the graphic display of other configurations.
[0058] The pad forming face 22a side of a substrate 22 is shown in drawing 7 . The wiring pattern 24 and the electrode pad 38 are formed in this pad forming face 22a. The wiring pattern 24 is formed in the shape of a stripe. Moreover, it has considered as the configuration where four round shapes connected the pattern of the electrode pad 38 linearly. Each round shape adjoined, and has touched at least that it is circular, or may overlap for a while. And each electrode pad 38 is connected to the edge of the wiring pattern 24, respectively. The circular array direction which constitutes the electrode pad 38 is made in agreement with the longitudinal direction of the wiring pattern 24. Orientation of each electrode pad 38 is carried out to the same direction. The spherical bump 28 is stuck to each of the circular part on this electrode pad 38 by pressure, respectively. In addition, the circular number which constitutes the electrode pad 38 can be made not only into four but into the two different numbers or more.
[0059] Since each spherical bump 28 after melting connects mutually, while the ratio of a bump's width of face and die length becomes large according to such an electrode pad 38, a plane-of-composition product increases. Therefore, since bump height becomes low by making small each spherical bump's 28 diameter of a bump, an aspect ratio can be enlarged. Thus, since bump height can be made low where an aspect ratio is kept high, height dispersion of the height direction after junction can be made small.
[0060] Moreover, as mentioned above, the breadth range of a bump's 28 direction of a field is regulated in the part of the radii of the electrode pad 38. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.
[0061] Moreover, it is suitable also for the electrode pad of a chip to make it the same configuration as the electrode pad 38 of a substrate 22. And it is good to arrange this electrode pad directly under the barrier layer of a semiconductor laser component (chip). Thus, a configuration comes to carry out heat transfer of the heat generated with a semiconductor laser component at good effectiveness through an electrode pad to a substrate 22 from a chip. This generated heat radiates heat outside through a package from a substrate 22. Therefore, the property of the semiconductor laser component formed in the chip is stabilized.

[0062] [Gestalt of the 4th operation] drawing 8 is the top view showing the 4th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 4th operation and the optical module of the gestalt of the 1st operation is in the point of the electrode pad configuration of a substrate, it shows only a substrate and its electrode pad to drawing 8 , and is omitting the graphic display of other configurations.
[0063] The pad forming face 22a side of a substrate 22 is shown in drawing 8 . The wiring pattern 24 and the electrode pad 40 are formed in this pad forming face 22a. The wiring pattern 24 is formed in the shape of a stripe. Moreover, four forward hexagons arrange the pattern of the electrode pad 40 linearly, and it has considered as the configuration which the sides which counter mutually [each forward hexagon] connected. Each electrode pad 40 is connected to the edge of the wiring pattern 24, respectively. Moreover, the array direction of the forward hexagon which constitutes the electrode pad 40 is made in agreement with the longitudinal direction of the wiring pattern 24. Orientation of each electrode pad 40 is carried out to the same direction. The spherical bump 28 is stuck to each of the forward hexagon part on this electrode pad 40 by pressure, respectively. In addition, the number of the forward hexagons which constitute the electrode pad 40 can be made not only into four but into the two different numbers or more.

[0064] Such an electrode pad 40 is making the include angle which is 60 degrees rather than has the array direction of a forward hexagon, and the parallel extension direction of the side of each forward hexagon. In each forward hexagon part, the breadth range of a bump 28 receives regulation to the direction vertical to two sides of a where the electrode pad 40 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c. Therefore, the breadth range of a bump 28 receives regulation to the longitudinal direction of the electrode pad 40, and the both directions of the direction of a short hand. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.
[0065] Moreover, since each spherical bump 28 after melting connects mutually, while the ratio of a bump's width of face and die length becomes large according to this electrode pad 40, a plane-of-composition product increases. Therefore, since bump height becomes low by making small each spherical bump's 28 diameter of a bump, an aspect ratio can be enlarged. Thus, since bump height can be made low where an aspect ratio is kept high, height dispersion of the height direction after junction can be made small.
[0066] Moreover, the electrode pad of a chip is also good to make it the same configuration as the electrode pad 40 of a substrate 22. And it is suitable to arrange this electrode pad directly under the barrier layer of a semiconductor laser component (chip). Thus, a configuration comes to carry out heat transfer of the heat generated with a semiconductor laser component at good effectiveness through an electrode pad to a substrate 22 from a chip. This generated heat radiates heat outside through a package from a substrate 22.
[0067] [Gestalt of the 5th operation] drawing 9 is the top view showing the 5th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 5th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 9 , and is omitting the graphic display of other configurations.
[0068] The pad forming face 30a side of a chip 30 is shown in drawing 9 . On pad forming face 30a, the rectangle region 42 is formed directly under each barrier layer 32 of a chip 30, respectively. The longitudinal direction of this rectangle region 42 is parallel to the longitudinal direction of a barrier layer 32. 1st electrode pad 44a is prepared in the location of the top-most vertices of this rectangle region 42, respectively. Therefore, around the barrier layer 32, four 1st electrode pad 44a is arranged. Moreover, one 2nd electrode pad 44b is prepared in the location of the intersection of the diagonal line of a rectangle region 42. The location in which this 2nd electrode pad 44b was prepared is a location which corresponds directly under a barrier layer 32. Moreover, the flat-surface configuration of these 1st and 2nd electrode pads 44a and 44b is made into the shape of a forward hexagon, respectively. And while each of 1st electrode pad 44a is carrying out orientation to the same direction, 2nd electrode pad 44b is carrying out orientation to the sense which rotated only the include angle of 30 degrees from the sense of 1st electrode pad 44a.
[0069] Thus, since 1st electrode pad 44a is prepared in each angle of a rectangle region 42, it is easy to amend hand-of-cut gap of the longitudinal direction of a barrier layer 32. This is the same principle as the approach of, performing the pattern recognition in wire bond on the square of a chip if possible, and making hand-of-cut gap small. Moreover, since 1st electrode pad 44a is a forward hexagon-like, it is as the gestalt of the 1st operation having described that gap of the direction of a flat surface can be made small. Furthermore, since 2nd electrode pad 44b of a pattern which rotated the pattern of 1st electrode

pad 44a 30 degrees under the barrier layer 32 is allotted, location gap is amended to a total of six directions. Therefore, even if it is an array configuration like the chip 30 of this example, location gap and dispersion of the direction of a flat surface can be made small. Moreover, since the electrode pad is prepared in the bottom of a barrier layer 32, the heat generated from the semiconductor laser component constituted by the chip 30 can be efficiently missed to a substrate.

[0070] [Gestalt of the 6th operation] drawing 10 is the top view showing the 6th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 6th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 10 , and is omitting the graphic display of other configurations.

[0071] The pad forming face 30a side of a chip 30 is shown in drawing 10 . On pad forming face 30a, the rectangle region 46 is formed directly under each barrier layer 32 of a chip 30, respectively. The longitudinal direction of this rectangle region 46 is parallel to the longitudinal direction of a barrier layer 32. 1st electrode pad 48a is prepared in the location of the top-most vertices of this rectangle region 46, respectively. Therefore, around a barrier layer 32, four 1st electrode pad 48a is arranged. Moreover, one 2nd electrode pad 48b is prepared in the location of the intersection of the diagonal line of a rectangle region 46. The location in which this 2nd electrode pad 48b was prepared corresponds directly under the barrier layer 32. Two sides are made into each configuration of three forward hexagons which explained the flat-surface configuration of these 1st and 2nd electrode pads 48a and 48b with the gestalt of the 2nd operation, respectively which it comes to connect mutually. And while each of 1st electrode pad 48a is carrying out orientation to the same direction, 2nd electrode pad 48b is carrying out orientation to the sense which rotated only the include angle of 30 degrees from the sense of 1st electrode pad 48a.

[0072] Thus, since it constitutes, as the gestalt of the 5th operation explained, it is easy to amend hand-of-cut gap of the longitudinal direction of a barrier layer 32. Moreover, since it is the configuration where each 1st electrode pad 48a connected three forward hexagons, gap of the direction of a flat surface can be made still smaller. Furthermore, since 2nd electrode pad 48b of a pattern which rotated the pattern of 1st electrode pad 48a 30 degrees under the barrier layer 32 is allotted, location gap is amended to a total of six directions. Therefore, the location precision of the part of the barrier layer 32 of a chip 30 increases further. Moreover, if a pattern like the 1st and 2nd electrode pads 48a and 48b is used, since bump height can be made low, taking a large aspect ratio, dispersion in the height direction also becomes small.

[0073] [Gestalt of the 7th operation] drawing 11 is the top view showing the 7th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 7th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 11 , and is omitting the graphic display of other configurations.

[0074] The pad forming face 30a side of a chip 30 is shown in drawing 11 . On pad forming face 30a, the rectangle region 50 is formed directly under each barrier layer 32 of a chip 30, respectively. The longitudinal direction of this rectangle region 50 is parallel to the longitudinal direction of a barrier layer 32. 1st electrode pad 52a is prepared in the location of the top-most vertices of this rectangle region 50, respectively. Therefore, around a barrier layer 32, four 1st electrode pad 52a is arranged. Moreover, one 2nd electrode pad 52b is prepared in the location of the intersection of the diagonal line of a rectangle region 50. The location in which this 2nd electrode pad 52b was prepared corresponds directly under the barrier layer 32. The flat-surface configuration of 1st electrode pad 52a is each configuration of three forward hexagons which were explained with the gestalt of the 2nd operation with which it comes to connect two sides mutually. Moreover, three forward hexagons are the configurations arranged linearly, and the flat-surface configuration of 2nd electrode pad 52b is a configuration which the sides which counter mutually [each forward hexagon] connected. And while each of 1st electrode pad 52a is carrying out orientation to the same direction, the sense of the forward hexagon which constitutes 2nd electrode pad 52b is carrying out orientation to the sense which rotated only the include angle of 30 degrees from the sense of the forward hexagon which constitutes 1st electrode pad 52a.

[0075] In addition, since the number of the forward hexagons which constitute 1st electrode pad 52a, and the number of the forward hexagons which constitute 2nd electrode pad 52b are made the same and each forward hexagon is made into the same magnitude, the area of 1st electrode pad 52a and 2nd electrode pad 52b becomes the same, and an aspect ratio becomes the same.

[0076] Moreover, since 2nd electrode pad 52b is located directly under a barrier layer 32, the heat from a barrier layer 32 has recess-come to be easy of b to a substrate 22. For this reason, the property of the semiconductor laser component constituted by the chip 30 is stabilized.

[0077] Thus, since it constitutes, as the gestalt of the 5th operation explained, it is easy to amend hand-of-cut gap of the longitudinal direction of a barrier layer 32. Moreover, since it is the configuration where

each 1st electrode pad 52a connected three forward hexagons, gap of the direction of a flat surface can be made still smaller. Moreover, since 2nd electrode pad 52b is made into the configuration where it explained with the gestalt of the 4th operation, where an aspect ratio is kept high, it can make bump height low, and can make small height dispersion of the height direction after junction. Furthermore, since the sense of the forward hexagon which constitutes 2nd electrode pad 52b is carrying out orientation to the sense which rotated only the include angle of 30 degrees from the sense of the forward hexagon which constitutes 1st electrode pad 52a, the breadth range of a bump will receive regulation from a total of six directions, and its junction location precision improves.

[0078] [Gestalt of the 8th operation] drawing 12 is drawing showing the 8th configuration of the optical module of the gestalt of operation. Drawing 12 (A) is the top view showing the pad forming face side of a substrate. Drawing 12 (B) is the top view showing the pad forming face side of a chip. Drawing 12 (C) is the top view showing the condition that the chip and the substrate were joined.

[0079] The wiring pattern 24 and the electrode pad 26 are formed in pad forming face 22a of a substrate 22. This wiring pattern 24 is a stripe-like, and two or more wiring patterns 24 have arranged each other to parallel on a substrate 22. Moreover, the pattern of the electrode pad 26 is made into the shape of a forward hexagon. This electrode pad 26 is connected to the edge of each wiring pattern 24. Orientation of each electrode pad 26 is carried out to the same direction.

[0080] Moreover, the wiring pad 54 of the shape of two or more forward hexagon is formed in pad forming face 30a of a chip 30. Each electrode pad 54 is arranged directly under the barrier layer, respectively. To the sense of the electrode pad 26 of a substrate 22, orientation of the sense of the electrode pad 54 of this chip 30 is carried out so that only the include angles of 30 degrees may differ mutually at the time of association.

[0081] And as shown in drawing 12 (C), the substrate 22 and the chip 30 are joined in the condition that between the electrode pad 26 and 54 doubled. It is joined by the spherical bump between these electrode pad 26 and 54. Self-alignment is performed and the junction location between a substrate 22 and a chip 30 is amended by the stability generated by this bump.

[0082] Thus, since the side of the forward hexagon which constitutes the electrode pad 54 of a chip 30, and the side of the forward hexagon which constitutes the electrode pad 26 of a substrate 22 are not parallel, the force of a hand of cut works at the time of self-alignment. Since two or more electrode pads are prepared in the chip 30 and the substrate 22, a chip 30 and a substrate 22 do not rotate actually. However, the force of this hand of cut acts effectively to self-alignment, consequently junction location precision is raised further. Therefore, even if it cannot use the pad which connected the forward hexagon, improvement in junction location precision can be aimed at.

[0083] [Gestalt of the 9th operation] drawing 13 is the top view showing the 9th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 9th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 13 , and is omitting the graphic display of other configurations.

[0084] The pad forming face 30a side of a chip 30 is shown in drawing 13 . The electrode pad 56 is formed on pad forming face 30a. As for this electrode pad 56, in directly under [of the barrier layer 32 of a chip 30], two or more forward hexagons serve as the configuration where the sides which counter mutually [each forward hexagon] were connected so that may be arranged in the shape of zigzag. The extension direction of this electrode pad 56 is made in agreement with the longitudinal direction of a barrier layer 32. Therefore, the heat generated from the barrier layer 32 of a chip 30 can be efficiently missed to a substrate 22 through the electrode pad 56.

[0085] Thus, since the whole pad area can be enlarged by combining two or more forward hexagons, by making size of each forward hexagon small, a bump's aspect ratio becomes large, therefore a bump's height can be made low. Therefore, since bump height can be made low where an aspect ratio is kept high, height dispersion of the height direction after junction can be made small.

[0086] Moreover, since the electrode pad 56 is a zigzag configuration, the breadth range of a bump comes to receive regulation to the longitudinal direction of an electrode pad, and the both directions of the direction of a short hand. For this reason, junction location precision increases compared with the case where the bump of the shape of a conventional stripe is used to a square-like electrode pad.

[0087] [Gestalt of the 10th operation] drawing 14 is the top view showing the 10th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 10th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 14 , and is omitting the graphic display of other configurations.

[0088] The pad forming face 30a side of a chip 30 is shown in drawing 14 . The electrode pad 58 is

formed on pad forming face 30a. This electrode pad 58 serves as a configuration which two or more honeycomb structures which connected six forward hexagons annularly and were acquired connected linearly in directly under [of the barrier layer 32 of a chip 30]. Moreover, the extension direction of this electrode pad 58, i.e., the connection direction of honeycomb structure, is made in agreement with the longitudinal direction of a barrier layer 32. Therefore, the heat generated from the barrier layer 32 of a chip 30 can be efficiently missed to a substrate 22 through the electrode pad 58.

[0089] Thus, the electrode pad 58 which arranged the forward hexagon annularly is used, and since the degree of freedom of the breadth range of a bump is restricted by each forward hexagon part, gap in the hand of cut between a chip and a substrate is canceled.

[0090] Moreover, according to this electrode pad 58, the whole pad area can be enlarged by combining two or more forward hexagons. As shown in drawing 14 , each honeycomb structure serves as a configuration which two forward hexagons arranged in the direction vertical to one piece and this connection direction in the connection direction of honeycomb structure. Therefore, since a bump's aspect ratio can be lowered and there is no part with a still larger area when this electrode pad 58 is used, height dispersion is also reduced. For this reason, precision dispersion of the direction of a flat surface and the height direction becomes small.

[0091]

[Effect of the Invention] According to the optical module of this invention, the flat-surface configuration of a substrate or the electrode pad of a chip is made into the shape of a forward hexagon. On this electrode pad, a spherical bump is stuck by pressure so that it may be inscribed in the side of an electrode pad. If this bump heat-treats, she will fuse, and she spreads in an electrode pad. Since this electrode pad is made into the shape of a forward hexagon, the breadth range of a bump receives regulation from a direction vertical to the side of a forward hexagon. That is, the breadth range of a bump receives regulation to the direction vertical to two sides which has countered mutually [an electrode pad]. Thus, according to this invention, the breadth range of a bump is regulated from three directions. Therefore, the regulation direction increases compared with the electrode pad of the shape of a conventional square, and the junction location precision of a chip and a substrate increases.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Generally, light corpuscle children, such as a laser diode array component of many channels and a photo detector array, are offered as an optical module, where dice bonding is carried out to a substrate. The optical axis of the optical coupling system constituted by the light corpuscle child of such an optical module has desirable no adjusting-izing. Therefore, generally alignment is performed to dice bonding and coincidence.

[0003] For example, according to the conventional technique indicated by reference "the 1995 Institute of Electronics, Information and Communication Engineers synthesis convention C-215", the chip formed as a light corpuscle child is combined by the solder bump to a substrate. If a solder bump becomes more than fixed magnitude with the ratio (aspect ratio) of height to a bump's width of face, the stability by surface tension will come to commit her by the solder bump in the condition of having fused. Self-alignment mounting is performed by using this stability.

[0004] Moreover, the advantage which uses a stripe-like bump is mentioned to the above-mentioned reference. If the diameter of a bump is enlarged in order that a common spherical bump may get bonding strength, a bump's height will also become large and the junction location precision of the height direction will fall. On the other hand, the stripe-like bump says that bump height can be reduced where a plane-of-composition product is secured.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to the optical module of this invention, the flat-surface configuration of a substrate or the electrode pad of a chip is made into the shape of a forward hexagon. On this electrode pad, a spherical bump is stuck by pressure so that it may be inscribed in the side of an electrode pad. If this bump heat-treats, she will fuse, and she spreads in an electrode pad. Since this electrode pad is made into the shape of a forward hexagon, the breadth range of a bump receives regulation from a direction vertical to the side of a forward hexagon. That is, the breadth range of a bump receives regulation to the direction vertical to two sides which has countered mutually [an electrode pad]. Thus, according to this invention, the breadth range of a bump is regulated from three directions. Therefore, the regulation direction increases compared with the electrode pad of the shape of a conventional square, and the junction location precision of a chip and a substrate increases.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, a stripe-like bump has problems [configuration], such as distortion and a cone. Therefore, a dispersion improvement effect to the extent that it expected is not accepted, but only a result with this insufficient approach is obtained. Therefore, it is expected that it is obtained that a result [use / the usual spherical bump] is more desirable. And since it explains below, improvement in the junction location precision of a chip and a substrate is expectable by devising the configuration of an electrode pad where a spherical bump is stuck by pressure.
[0006] Drawing 15 is a top view with which explanation of a technical problem is presented. As shown in drawing 15 , the square-like electrode pad 10 is formed on the conventional substrate or the chip 11. On this electrode pad 10, the spherical bump 12 is stuck by pressure so that it may be inscribed in the side of the electrode pad 10. A bump 12 will fuse, if a reflow etc. is heat-treated, and she spreads in the electrode pad 10. The breadth range of a bump 12 is restricted in the location of the side of the shape of a straight line of the electrode pad 10. For this reason, the breadth range of x directions and the direction of y in drawing 15 of a bump 12 is regulated. Thus, the usual electrode pad 10 has secured junction location precision by regulating the breadth range of a bump 12 from a 2-way. Therefore, if this regulation direction can be increased, junction location precision will improve.
[0007] In addition, if the configuration of an electrode pad is made circular, the regulation direction mentioned above will increase most. However, since a degree of freedom is completely lost, it becomes the column configuration where the bump configuration when seeing from a side face inclined, and precision will be dropped on reverse.
[0008] Invention concerning this application is made in view of the above-mentioned point, and aims at improvement in the junction location precision of the chip and substrate in an optical module.

[Translation done.]

MEANS

[Means for Solving the Problem] That is, according to the optical module of invention concerning this application, in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump, it is characterized by making the flat-surface configuration of the both sides of a chip and a substrate, or one of electrode pads into the shape of a forward hexagon.
[0010] Drawing 1 is a top view with which explanation of the operation effectiveness of the optical module of this 1st invention is presented. As shown in drawing 1 , the forward hexagon-like electrode pad 14 is formed on the substrate or the chip 11. On this electrode pad 14, the spherical bump 12 is stuck by pressure so that it may be inscribed in the side of the electrode pad 14. If this bump 12 heat-treats, she will fuse, and she spreads in the electrode pad 14. At this time, the breadth range of a bump 12 receives regulation from a direction vertical to the side of a forward hexagon. That is, the breadth range of a bump 12 receives regulation to the direction vertical to two sides of a where the electrode pad 14 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c. Thus, according to this invention, an electrode pad is written as the shape of a forward hexagon, and the breadth range of a bump 12 comes to be regulated from three directions. Therefore, the regulation direction increases compared with the electrode pad of the shape of a conventional square, and the junction location precision of a chip and a substrate increases.
[0011] Moreover, according to the optical module of other invention concerning this application, it sets to the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump. It is the configuration where three forward hexagons connected the flat-surface configuration of the both sides of a chip and a substrate, or one of electrode pads, and is characterized by considering as the configuration which one side of the forward hexagon of everything [sides / two] but each forward hexagon connected, respectively.
[0012] Drawing 2 is a top view with which explanation of the operation effectiveness of the optical module of this 2nd invention is presented. As shown in drawing 2 , each electrode pad 16 of a configuration of three forward hexagons with which it comes to connect two sides mutually is formed on the substrate or the chip 11. On this electrode pad 16, three spherical bumps 12 are stuck by pressure. Each bump 12 is stuck by pressure so that it may be inscribed in the side of three forward hexagons which constitute the electrode pad 16, respectively. If each bump 12 heat-treats, she will fuse, and she spreads in the electrode pad 16. The breadth range of this bump 12 receives regulation in the part of the side of the electrode pad 16. That is, the breadth range of a bump 12 receives regulation to the direction vertical to two sides of a where the electrode pad 16 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c.
[0013] Thus, as for the electrode pad of this invention, the breadth range of a bump is regulated from three directions. Therefore, the junction location precision of a chip and a substrate increases compared with the electrode pad of the shape of a conventional square.
[0014] Furthermore, the bump configuration shown in drawing 2 is equivalent to the configuration where the stripe-like bump extended to each of the direction of a, the direction of b, and the direction of c. Therefore, since a plane-of-composition product becomes large and only the part can make a bump's height low, height dispersion of the height direction after junction can be made small.
[0015] Moreover, it is characterized by considering as the configuration where two or more round shapes connected [application / this / pan / to apply] linearly the flat-surface configuration of the both sides of a chip and a substrate, or one of electrode pads in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump according to the optical module of other invention.
[0016] Drawing 3 is a top view with which explanation of the operation effectiveness of the optical module

of this 3rd invention is presented. As shown in drawing 3 , the electrode pad 18 of a configuration which two or more round shapes connected linearly is formed on the substrate or the chip 11. On this electrode pad 18, after the spherical bump 12 of a circular number and the same number has arranged linearly, it is stuck by pressure. If each bump 12 heat-treats, she will fuse, and she spreads in the electrode pad 18. The breadth range of this bump 12 receives regulation in the part of the radii of the electrode pad 18.
[0017] According to the above-mentioned electrode pad, since each spherical bump after melting connects mutually, a plane-of-composition product increases. Therefore, by making small each spherical bump's diameter of a bump, where an aspect ratio is kept high, bump height can be made low. Therefore, height dispersion of the height direction after junction can be made small.
[0018] Moreover, as mentioned above, the breadth range of a bump's direction of a field is regulated in the part of the radii of the electrode pad arranged to the circular connection direction. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.
[0019] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump. It is the configuration where two or more forward hexagons arranged linearly the flat-surface configuration of the both sides of a chip and a substrate, or one of electrode pads, and is characterized by considering as the configuration which the sides which counter mutually [each forward hexagon] connected.
[0020] Drawing 4 is a top view with which explanation of the operation effectiveness of the optical module of this 4th invention is presented. As shown in drawing 4 , the electrode pad 20 of a configuration which two or more forward hexagons connected linearly is formed on the substrate or the chip 11. On this electrode pad 20, after the spherical bump 12 of the number of forward hexagons and the same number has arranged linearly, it is stuck by pressure. If each bump 12 heat-treats, she will fuse, and she spreads in the electrode pad 20. The breadth range of this bump 12 receives regulation in the part of the side of the electrode pad 20. That is, the breadth range of a bump 12 receives regulation to the direction vertical to two sides of a where the electrode pad 20 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c.
[0021] According to the above-mentioned electrode pad, since each spherical bump after melting connects mutually, a plane-of-composition product increases. Therefore, by making small each spherical bump's diameter of a bump, where an aspect ratio is kept high, bump height can be made low. Therefore, height dispersion of the height direction after junction can be made small.
[0022] Moreover, since it is the configuration which extends while the configuration of the side which extends in the connection direction of a forward hexagon of the electrode pad 20 bends in the shape of zigzag at the include angle of 60 degrees, the breadth range of a bump 12 receives regulation to the longitudinal direction of the electrode pad 20, and the both directions of the direction of a short hand by this side. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.
[0023] Moreover, in the optical module of each invention mentioned above, it is good preferably to prepare the electrode pad of a chip directly under the barrier layer of a chip.
[0024] Thus, if constituted, the heat generated from the barrier layer of a chip can be efficiently missed to a substrate through an electrode pad. Therefore, the property of a chip is stabilized.
[0025] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad and the electrode pad of a substrate which were prepared in the pad forming face of a chip were joined by the bump. The 1st electrode pad prepared in the location of the top-most vertices of a rectangle region where the electrode pad of a chip was formed by the pad forming face, While consisting of the 2nd electrode pad prepared in the location of the intersection of the diagonal line of this rectangle region, the flat-surface configuration of the 1st and 2nd electrode pad being a forward hexagon-like, respectively and each of the 1st electrode pad carrying out orientation to the same direction It is characterized by carrying out orientation to the sense to which the 2nd electrode pad rotated only the include angle of 30 degrees from the sense of the 1st electrode pad.
[0026] Thus, since the 1st electrode pad is prepared in the location of the four corners of a rectangle region, gap of the hand of cut of a chip is easy to be amended. Moreover, since each 1st electrode pad is a forward hexagon-like, gap of the direction of a flat surface can be made small. Furthermore, the forward hexagon-like 2nd electrode pad is prepared in the location of the intersection of the diagonal line of a rectangle region, and it is made the sense which only the include angle of 30 degrees made rotate the sense of this 2nd electrode pad from the sense of the 1st electrode pad. Therefore, location gap of a chip is amended to a total of six directions.

[0027] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad and the electrode pad of a substrate which were prepared in the pad forming face of a chip were joined by the bump. The 1st electrode pad prepared in the location of the top-most vertices of a rectangle region where the electrode pad of a chip was formed by the pad forming face, It consists of the 2nd electrode pad prepared in the location of the intersection of the diagonal line of this rectangle region. While the flat-surface configuration of the 1st and 2nd electrode pad is each configuration of three forward hexagons with which it comes to connect two sides mutually, respectively and each of the 1st electrode pad is carrying out orientation to the same direction It is characterized by carrying out orientation to the sense to which the 2nd electrode pad rotated only the include angle of 30 degrees from the sense of the 1st electrode pad.
[0028] Thus, since the 1st electrode pad is prepared in the location of the four corners of a rectangle region, gap of the hand of cut of a chip is easy to be amended. Moreover, since it is the configuration where each 1st electrode pad connected three forward hexagons, gap of the direction of a flat surface can be made small. Furthermore, the 2nd electrode pad of a configuration which three forward hexagons connected is prepared in the location of the intersection of the diagonal line of a rectangle region, and it is made the sense which only the include angle of 30 degrees made rotate the sense of this 2nd electrode pad from the sense of the 1st electrode pad. Therefore, location gap of a chip is amended to a total of six directions. Moreover, since bump height can be made low according to the 1st and 2nd electrode pad, taking a large aspect ratio, dispersion in the height direction also becomes small.
[0029] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad and the electrode pad of a substrate which were prepared in the pad forming face of a chip were joined by the bump. The 1st electrode pad prepared in the location of the top-most vertices of a rectangle region where the electrode pad of a chip was formed by the pad forming face, It consists of the 2nd electrode pad prepared in the location of the intersection of the diagonal line of this rectangle region. The flat-surface configuration of the 1st electrode pad Two sides are each configurations of three forward hexagons which it comes to connect mutually, and the flat-surface configuration of the 2nd electrode pad is characterized by for three forward hexagons being the configurations arranged linearly, and being the configuration which the sides which counter mutually [each forward hexagon] connected.
[0030] Thus, since the 1st electrode pad is prepared in the location of the four corners of a rectangle region, gap of the hand of cut of a chip is easy to be amended. Moreover, since it is the configuration where each 1st electrode pad connected three forward hexagons, gap of the direction of a flat surface can be made small. Furthermore, the 2nd electrode pad of a configuration which three forward hexagons connected linearly is prepared in the location of the intersection of the diagonal line of a rectangle region. Therefore, location gap of a chip becomes small. Moreover, since bump height can be made low according to the 1st and 2nd electrode pad, taking a large aspect ratio, dispersion in the height direction also becomes small.
[0031] Moreover, it is good to make each above-mentioned rectangle region into the field formed so that the 2nd electrode pad might be located directly under the barrier layer of a chip preferably.
[0032] Thus, if constituted, the heat generated from the barrier layer of a chip can be efficiently missed to a substrate through an electrode pad.
[0033] Moreover, according to the optical module of other invention to the pan concerning this application, it sets to the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump. The flat-surface configuration of a chip and the electrode pad of the both sides of a substrate is made into the shape of a forward hexagon, and the sense of the electrode pad of a chip and the sense of the electrode pad of a substrate are characterized by carrying out orientation, respectively so that only the include angles of 30 degrees may differ mutually at the time of association.
[0034] Thus, according to this invention, since the breadth range of a bump receives regulation with a forward hexagon-like electrode pad, the junction location precision of a chip and a substrate becomes high compared with the former. Moreover, since the side of the electrode pad of a substrate and the side of the electrode pad of a chip are not parallel, the force of a hand of cut works by the bump who fused. If two or more electrode pads are in a chip and a substrate, a chip and a substrate will not rotate. The force of this hand of cut is committed effective in self-alignment, and junction location precision is raised further.
[0035] Moreover, according to the optical module of other invention to the pan concerning this application, in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump, it is characterized by consider as the configuration where the sides which counter mutually [each forward hexagon] were connected so that two or more forward hexagons may be arranged in the shape of zigzag in the flat surface configuration of the both sides of a chip and a

substrate, or one of electrode pads.
[0036] According to the electrode pad in this invention, since each spherical bump after melting connects mutually, a plane-of-composition product increases. Therefore, by making small each spherical bump's diameter of a bump, where an aspect ratio is kept high, bump height can be made low. Therefore, height dispersion of the height direction after junction can be made small. Moreover, since the electrode pad is made into the zigzag configuration, the breadth range of a bump receives regulation to the longitudinal direction of an electrode pad, and the both directions of the direction of a short hand. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.
[0037] In addition, preferably, while preparing the electrode pad of a chip directly under the barrier layer of a chip, it is good to make the extension direction of this electrode pad in agreement with the longitudinal direction of a barrier layer.
[0038] Thus, if constituted, the heat generated from the barrier layer of a chip can be efficiently missed to a substrate through an electrode pad.
[0039] Moreover, it is characterized by considering as the configuration which two or more honeycomb structures which connected annularly and were acquired [hexagons / six / forward] in the optical module to which the electrode pad of a chip and the electrode pad of a substrate were joined by the bump in the flat-surface configuration of the both sides of a chip and a substrate or one of electrode pads connected [application / this / pan / to apply] linearly according to the optical module of other invention.
[0040] If such annular honeycomb structure is used, location gap of a hand of cut will be canceled and junction location precision will improve.
[0041] Moreover, preferably, while preparing the electrode pad of a chip directly under the barrier layer of a chip, it is good to make the array direction of honeycomb structure in agreement with the longitudinal direction of a barrier layer.
[0042] Thus, if constituted, the heat generated from the barrier layer of a chip can be efficiently missed to a substrate through an electrode pad.
[0043] In the optical module of this invention, it is good preferably to use the above-mentioned chip as a semiconductor laser component, a photo detector, or an electric-field absorption mold light modulation element.
[0044]
[Embodiment of the Invention] Hereafter, with reference to drawing, it explains per gestalt of implementation of this invention. In addition, drawing shows a configuration, magnitude, and arrangement relation roughly to extent which can understand this invention. Moreover, conditions, ingredients, etc., such as a numeric value indicated below, are only mere examples. Therefore, this invention is not limited to the gestalt of this operation at all.
[0045] [Gestalt of the 1st operation] drawing 5 is drawing showing the 1st configuration of the optical module of the gestalt of operation. As for this optical module, the electrode pad of a chip and the electrode pad of a substrate are joined by the bump. Drawing 5 (A) is the top view showing the pad forming face side of a substrate. Drawing 5 (B) is the top view showing the pad forming face side of a chip. Drawing 5 (C) is the side elevation showing the condition that the chip and the substrate are joined by the bump.
[0046] Silicon, a ceramic, etc. are used for the substrate 22. The wiring pattern 24 and the dice bonding pad (an electrode pad is called hereafter.) 26 are formed in pad forming face 22a of a substrate 22. These wiring pattern 24 and the electrode pad 26 gold-plate on the surface of chrome plating, respectively. The wiring pattern 24 of this example is formed in the shape of a stripe. On a substrate 22, two or more wiring patterns 24 have arranged to parallel mutually. Moreover, the pattern of the electrode pad 26 is made into the shape of a forward hexagon. This electrode pad 26 is connected to the edge of each wiring pattern 24. Orientation of each electrode pad 26 is carried out to the same direction. on this electrode pad 26, the spherical solder bump (the following and a spherical bump -- or a bump is only called.) 28 is stuck by pressure so that it may be inscribed in the side of a forward hexagon.
[0047] Moreover, the chip 30 of this example is constituted as a laser diode array component (semiconductor laser component). The stripe-like barrier layer 32 is made in this chip 30. Two or more barrier layers 32 in a chip 30 are mutually arranged to parallel. The wiring pad (an electrode pad is called hereafter.) 34 of the shape of two or more square is formed in pad forming face 30a of this chip 30. Each electrode pad 34 is arranged directly under the barrier layer 32, respectively. This electrode pad 34 may be made into the shape of a forward hexagon as well as the electrode pad 26 of a substrate 22.
[0048] And the pad forming faces 22a and 30a of a substrate 22 and a chip 30 are made to have countered. In this condition, the location of the electrode pad 26 of a substrate 22 and the location of the electrode pad 34 of a chip 30 suit. And between these electrode pad 26 and 34 is joined by the spherical

bump 28. As mentioned above, the spherical bump 28 is first stuck by pressure on the electrode pad 26 of a substrate 22. Then, a chip 30 is laid where the electrode pad 34 is set on a bump 28. In this condition, if it lets these substrates 22 and a chip 30 pass to a reflow tub, a bump 28 will melt and during a substrate 22 and a chip 30 will be joined. In this process, the stability generated by the bump 28 amends the junction location between a substrate 22 and a chip 30. That is, self-alignment is performed.
[0049] With the gestalt of this operation, since the forward hexagon-like electrode pad 26 is used as shown in drawing 5 (A), the breadth range of the bump 28 at the time of melting receives regulation to the direction vertical to two sides of a where the electrode pad 26 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c. Therefore, since the breadth range of a bump 28 will be regulated from three directions and the regulation direction increases compared with the electrode pad of the shape of a conventional square, the junction location precision of a chip 30 and a substrate 22 increases.
[0050] Thus, from a barrier layer 32, if the constituted optical module is operated, while light occurs, heat will occur with the carrier used as light. Since the electrode pad 34 is provided directly under the barrier layer 32 as mentioned above, this heat escapes at good effectiveness to a substrate 22 through the electrode pad 34, a bump 28, and the electrode pad 26.
[0051] In addition, although the chip 30 was used as the semiconductor laser component with the gestalt of this operation, it is good also not only considering this but the chip 30 as a photo detector or an electric-field absorption mold light modulation element.
[0052] [Gestalt of the 2nd operation] drawing 6 is the top view showing the 2nd configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 2nd operation and the optical module of the gestalt of the 1st operation is in the point of the electrode pad configuration of a substrate, it shows only a substrate and its electrode pad to drawing 6 , and is omitting the graphic display of other configurations.
[0053] The pad forming face 22a side of a substrate 22 is shown in drawing 6 . The wiring pattern 24 and the electrode pad 36 are formed in this pad forming face 22a. The wiring pattern 24 is formed in the shape of a stripe. Moreover, two sides make the pattern of the electrode pad 36 each configuration of three forward hexagons which it comes to connect mutually. Each electrode pad 36 is connected to the edge of the wiring pattern 24, respectively. Moreover, orientation of each electrode pad 36 is carried out to the same direction. On this electrode pad 36, three spherical bumps 28 are stuck by pressure so that it may be inscribed in the side of a forward hexagon.
[0054] Since the electrode pad 36 of the configuration which consists of three forward hexagons is used as shown in drawing 6 , the breadth range of the bump 28 at the time of melting receives regulation to the direction vertical to two sides of a where the electrode pad 36 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c. Therefore, since the breadth range of a bump 28 will be regulated from three directions and the regulation direction increases compared with the electrode pad of the shape of a conventional square, the junction location precision of a chip and a substrate 22 increases.

[0055] Furthermore, a bump's 28 configuration shown in drawing 6 is equivalent to the configuration where the stripe-like bump extended to each of the direction of a, the direction of b, and the direction of c. Therefore, since a plane-of-composition product becomes large and only the part can make a bump's 28 height low, height dispersion of the height direction after junction can be made small.
[0056] In addition, it is suitable also for the electrode pad of a chip to make it the same configuration as the electrode pad 36 of a substrate 22.
[0057] [Gestalt of the 3rd operation] drawing 7 is the top view showing the 3rd configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 3rd operation and the optical module of the gestalt of the 1st operation is in the point of the electrode pad configuration of a substrate, it shows only a substrate and its electrode pad to drawing 7 , and is omitting the graphic display of other configurations.
[0058] The pad forming face 22a side of a substrate 22 is shown in drawing 7 . The wiring pattern 24 and the electrode pad 38 are formed in this pad forming face 22a. The wiring pattern 24 is formed in the shape of a stripe. Moreover, it has considered as the configuration where four round shapes connected the pattern of the electrode pad 38 linearly. Each round shape adjoined, and has touched at least that it is circular, or may overlap for a while. And each electrode pad 38 is connected to the edge of the wiring pattern 24, respectively. The circular array direction which constitutes the electrode pad 38 is made in agreement with the longitudinal direction of the wiring pattern 24. Orientation of each electrode pad 38 is carried out to the same direction. The spherical bump 28 is stuck to each of the circular part on this electrode pad 38 by pressure, respectively. In addition, the circular number which constitutes the electrode pad 38 can be made not only into four but into the two different numbers or more.

[0059] Since each spherical bump 28 after melting connects mutually, while the ratio of a bump's width of face and die length becomes large according to such an electrode pad 38, a plane-of-composition product increases. Therefore, since bump height becomes low by making small each spherical bump's 28 diameter of a bump, an aspect ratio can be enlarged. Thus, since bump height can be made low where an aspect ratio is kept high, height dispersion of the height direction after junction can be made small.
[0060] Moreover, as mentioned above, the breadth range of a bump's 28 direction of a field is regulated in the part of the radii of the electrode pad 38. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.
[0061] Moreover, it is suitable also for the electrode pad of a chip to make it the same configuration as the electrode pad 38 of a substrate 22. And it is good to arrange this electrode pad directly under the barrier layer of a semiconductor laser component (chip). Thus, a configuration comes to carry out heat transfer of the heat generated with a semiconductor laser component at good effectiveness through an electrode pad to a substrate 22 from a chip. This generated heat radiates heat outside through a package from a substrate 22. Therefore, the property of the semiconductor laser component formed in the chip is stabilized.
[0062] [Gestalt of the 4th operation] drawing 8 is the top view showing the 4th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 4th operation and the optical module of the gestalt of the 1st operation is in the point of the electrode pad configuration of a substrate, it shows only a substrate and its electrode pad to drawing 8 , and is omitting the graphic display of other configurations.
[0063] The pad forming face 22a side of a substrate 22 is shown in drawing 8 . The wiring pattern 24 and the electrode pad 40 are formed in this pad forming face 22a. The wiring pattern 24 is formed in the shape of a stripe. Moreover, four forward hexagons arrange the pattern of the electrode pad 40 linearly, and it has considered as the configuration which the sides which counter mutually [each forward hexagon] connected. Each electrode pad 40 is connected to the edge of the wiring pattern 24, respectively. Moreover, the array direction of the forward hexagon which constitutes the electrode pad 40 is made in agreement with the longitudinal direction of the wiring pattern 24. Orientation of each electrode pad 40 is carried out to the same direction. The spherical bump 28 is stuck to each of the forward hexagon part on this electrode pad 40 by pressure, respectively. In addition, the number of the forward hexagons which constitute the electrode pad 40 can be made not only into four but into the two different numbers or more.

[0064] Such an electrode pad 40 is making the include angle which is 60 degrees rather than has the array direction of a forward hexagon, and the parallel extension direction of the side of each forward hexagon. In each forward hexagon part, the breadth range of a bump 28 receives regulation to the direction vertical to two sides of a where the electrode pad 40 has countered mutually, i.e., the direction in drawing, the direction of b, and the direction of c. Therefore, the breadth range of a bump 28 receives regulation to the longitudinal direction of the electrode pad 40, and the both directions of the direction of a short hand. For this reason, junction location precision increases compared with the case where the conventional stripe-like bump is used to a square-like electrode pad.
[0065] Moreover, since each spherical bump 28 after melting connects mutually, while the ratio of a bump's width of face and die length becomes large according to this electrode pad 40, a plane-of-composition product increases. Therefore, since bump height becomes low by making small each spherical bump's 28 diameter of a bump, an aspect ratio can be enlarged. Thus, since bump height can be made low where an aspect ratio is kept high, height dispersion of the height direction after junction can be made small.
[0066] Moreover, the electrode pad of a chip is also good to make it the same configuration as the electrode pad 40 of a substrate 22. And it is suitable to arrange this electrode pad directly under the barrier layer of a semiconductor laser component (chip). Thus, a configuration comes to carry out heat transfer of the heat generated with a semiconductor laser component at good effectiveness through an electrode pad to a substrate 22 from a chip. This generated heat radiates heat outside through a package from a substrate 22.
[0067] [Gestalt of the 5th operation] drawing 9 is the top view showing the 5th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 5th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 9 , and is omitting the graphic display of other configurations.
[0068] The pad forming face 30a side of a chip 30 is shown in drawing 9 . On pad forming face 30a, the rectangle region 42 is formed directly under each barrier layer 32 of a chip 30, respectively. The longitudinal direction of this rectangle region 42 is parallel to the longitudinal direction of a barrier layer 32.

1st electrode pad 44a is prepared in the location of the top-most vertices of this rectangle region 42, respectively. Therefore, around the barrier layer 32, four 1st electrode pad 44a is arranged. Moreover, one 2nd electrode pad 44b is prepared in the location of the intersection of the diagonal line of a rectangle region 42. The location in which this 2nd electrode pad 44b was prepared is a location which corresponds directly under a barrier layer 32. Moreover, the flat-surface configuration of these 1st and 2nd electrode pads 44a and 44b is made into the shape of a forward hexagon, respectively. And while each of 1st electrode pad 44a is carrying out orientation to the same direction, 2nd electrode pad 44b is carrying out orientation to the sense which rotated only the include angle of 30 degrees from the sense of 1st electrode pad 44a.

[0069] Thus, since 1st electrode pad 44a is prepared in each angle of a rectangle region 42, it is easy to amend hand-of-cut gap of the longitudinal direction of a barrier layer 32. This is the same principle as the approach of, performing the pattern recognition in wire bond on the square of a chip if possible, and making hand-of-cut gap small. Moreover, since 1st electrode pad 44a is a forward hexagon-like, it is as the gestalt of the 1st operation having described that gap of the direction of a flat surface can be made small. Furthermore, since 2nd electrode pad 44b of a pattern which rotated the pattern of 1st electrode pad 44a 30 degrees under the barrier layer 32 is allotted, location gap is amended to a total of six directions. Therefore, even if it is an array configuration like the chip 30 of this example, location gap and dispersion of the direction of a flat surface can be made small. Moreover, since the electrode pad is prepared in the bottom of a barrier layer 32, the heat generated from the semiconductor laser component constituted by the chip 30 can be efficiently missed to a substrate.

[0070] [Gestalt of the 6th operation] drawing 10 is the top view showing the 6th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 6th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 10 , and is omitting the graphic display of other configurations.

[0071] The pad forming face 30a side of a chip 30 is shown in drawing 10 . On pad forming face 30a, the rectangle region 46 is formed directly under each barrier layer 32 of a chip 30, respectively. The longitudinal direction of this rectangle region 46 is parallel to the longitudinal direction of a barrier layer 32. 1st electrode pad 48a is prepared in the location of the top-most vertices of this rectangle region 46, respectively. Therefore, around a barrier layer 32, four 1st electrode pad 48a is arranged. Moreover, one 2nd electrode pad 48b is prepared in the location of the intersection of the diagonal line of a rectangle region 46. The location in which this 2nd electrode pad 48b was prepared corresponds directly under the barrier layer 32. Two sides are made into each configuration of three forward hexagons which explained the flat-surface configuration of these 1st and 2nd electrode pads 48a and 48b with the gestalt of the 2nd operation, respectively which it comes to connect mutually. And while each of 1st electrode pad 48a is carrying out orientation to the same direction, 2nd electrode pad 48b is carrying out orientation to the sense which rotated only the include angle of 30 degrees from the sense of 1st electrode pad 48a.

[0072] Thus, since it constitutes, as the gestalt of the 5th operation explained, it is easy to amend hand-of-cut gap of the longitudinal direction of a barrier layer 32. Moreover, since it is the configuration where each 1st electrode pad 48a connected three forward hexagons, gap of the direction of a flat surface can be made still smaller. Furthermore, since 2nd electrode pad 48b of a pattern which rotated the pattern of 1st electrode pad 48a 30 degrees under the barrier layer 32 is allotted, location gap is amended to a total of six directions. Therefore, the location precision of the part of the barrier layer 32 of a chip 30 increases further. Moreover, if a pattern like the 1st and 2nd electrode pads 48a and 48b is used, since bump height can be made low, taking a large aspect ratio, dispersion in the height direction also becomes small.

[0073] [Gestalt of the 7th operation] drawing 11 is the top view showing the 7th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 7th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 11 , and is omitting the graphic display of other configurations.

[0074] The pad forming face 30a side of a chip 30 is shown in drawing 11 . On pad forming face 30a, the rectangle region 50 is formed directly under each barrier layer 32 of a chip 30, respectively. The longitudinal direction of this rectangle region 50 is parallel to the longitudinal direction of a barrier layer 32. 1st electrode pad 52a is prepared in the location of the top-most vertices of this rectangle region 50, respectively. Therefore, around a barrier layer 32, four 1st electrode pad 52a is arranged. Moreover, one 2nd electrode pad 52b is prepared in the location of the intersection of the diagonal line of a rectangle region 50. The location in which this 2nd electrode pad 52b was prepared corresponds directly under the barrier layer 32. The flat-surface configuration of 1st electrode pad 52a is each configuration of three forward hexagons which were explained with the gestalt of the 2nd operation with which it comes to

connect two sides mutually. Moreover, three forward hexagons are the configurations arranged linearly, and the flat-surface configuration of 2nd electrode pad 52b is a configuration which the sides which counter mutually [each forward hexagon] connected. And while each of 1st electrode pad 52a is carrying out orientation to the same direction, the sense of the forward hexagon which constitutes 2nd electrode pad 52b is carrying out orientation to the sense which rotated only the include angle of 30 degrees from the sense of the forward hexagon which constitutes 1st electrode pad 52a.

[0075] In addition, since the number of the forward hexagons which constitute 1st electrode pad 52a, and the number of the forward hexagons which constitute 2nd electrode pad 52b are made the same and each forward hexagon is made into the same magnitude, the area of 1st electrode pad 52a and 2nd electrode pad 52b becomes the same, and an aspect ratio becomes the same.

[0076] Moreover, since 2nd electrode pad 52b is located directly under a barrier layer 32, the heat from a barrier layer 32 has recess-come to be easy of b to a substrate 22. For this reason, the property of the semiconductor laser component constituted by the chip 30 is stabilized.

[0077] Thus, since it constitutes, as the gestalt of the 5th operation explained, it is easy to amend hand-of-cut gap of the longitudinal direction of a barrier layer 32. Moreover, since it is the configuration where each 1st electrode pad 52a connected three forward hexagons, gap of the direction of a flat surface can be made still smaller. Moreover, since 2nd electrode pad 52b is made into the configuration where it explained with the gestalt of the 4th operation, where an aspect ratio is kept high, it can make bump height low, and can make small height dispersion of the height direction after junction. Furthermore, since the sense of the forward hexagon which constitutes 2nd electrode pad 52b is carrying out orientation to the sense which rotated only the include angle of 30 degrees from the sense of the forward hexagon which constitutes 1st electrode pad 52a, the breadth range of a bump will receive regulation from a total of six directions, and its junction location precision improves.

[0078] [Gestalt of the 8th operation] drawing 12 is drawing showing the 8th configuration of the optical module of the gestalt of operation. Drawing 12 (A) is the top view showing the pad forming face side of a substrate. Drawing 12 (B) is the top view showing the pad forming face side of a chip. Drawing 12 (C) is the top view showing the condition that the chip and the substrate were joined.

[0079] The wiring pattern 24 and the electrode pad 26 are formed in pad forming face 22a of a substrate 22. This wiring pattern 24 is a stripe-like, and two or more wiring patterns 24 have arranged each other to parallel on a substrate 22. Moreover, the pattern of the electrode pad 26 is made into the shape of a forward hexagon. This electrode pad 26 is connected to the edge of each wiring pattern 24. Orientation of each electrode pad 26 is carried out to the same direction.

[0080] Moreover, the wiring pad 54 of the shape of two or more forward hexagon is formed in pad forming face 30a of a chip 30. Each electrode pad 54 is arranged directly under the barrier layer, respectively. To the sense of the electrode pad 26 of a substrate 22, orientation of the sense of the electrode pad 54 of this chip 30 is carried out so that only the include angles of 30 degrees may differ mutually at the time of association.

[0081] And as shown in drawing 12 (C), the substrate 22 and the chip 30 are joined in the condition that between the electrode pad 26 and 54 doubled. It is joined by the spherical bump between these electrode pad 26 and 54. Self-alignment is performed and the junction location between a substrate 22 and a chip 30 is amended by the stability generated by this bump.

[0082] Thus, since the side of the forward hexagon which constitutes the electrode pad 54 of a chip 30, and the side of the forward hexagon which constitutes the electrode pad 26 of a substrate 22 are not parallel, the force of a hand of cut works at the time of self-alignment. Since two or more electrode pads are prepared in the chip 30 and the substrate 22, a chip 30 and a substrate 22 do not rotate actually. However, the force of this hand of cut acts effectively to self-alignment, consequently junction location precision is raised further. Therefore, even if it cannot use the pad which connected the forward hexagon, improvement in junction location precision can be aimed at.

[0083] [Gestalt of the 9th operation] drawing 13 is the top view showing the 9th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 9th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 13 , and is omitting the graphic display of other configurations.

[0084] The pad forming face 30a side of a chip 30 is shown in drawing 13 . The electrode pad 56 is formed on pad forming face 30a. As for this electrode pad 56, in directly under [of the barrier layer 32 of a chip 30], two or more forward hexagons serve as the configuration where the sides which counter mutually [each forward hexagon] were connected so that may be arranged in the shape of zigzag. The extension direction of this electrode pad 56 is made in agreement with the longitudinal direction of a barrier layer 32. Therefore, the heat generated from the barrier layer 32 of a chip 30 can be efficiently

missed to a substrate 22 through the electrode pad 56.
[0085] Thus, since the whole pad area can be enlarged by combining two or more forward hexagons, by making size of each forward hexagon small, a bump's aspect ratio becomes large, therefore a bump's height can be made low. Therefore, since bump height can be made low where an aspect ratio is kept high, height dispersion of the height direction after junction can be made small.
[0086] Moreover, since the electrode pad 56 is a zigzag configuration, the breadth range of a bump comes to receive regulation to the longitudinal direction of an electrode pad, and the both directions of the direction of a short hand. For this reason, junction location precision increases compared with the case where the bump of the shape of a conventional stripe is used to a square-like electrode pad.
[0087] [Gestalt of the 10th operation] drawing 14 is the top view showing the 10th configuration of the optical module of the gestalt of operation. Since the point of difference between the optical module of the gestalt of this 10th operation and the optical module of the gestalt of the 1st operation is in the point of arrangement of the electrode pad of a chip, it shows only a chip and its electrode pad to drawing 14 , and is omitting the graphic display of other configurations.
[0088] The pad forming face 30a side of a chip 30 is shown in drawing 14 . The electrode pad 58 is formed on pad forming face 30a. This electrode pad 58 serves as a configuration which two or more honeycomb structures which connected six forward hexagons annularly and were acquired connected linearly in directly under [of the barrier layer 32 of a chip 30]. Moreover, the extension direction of this electrode pad 58, i.e., the connection direction of honeycomb structure, is made in agreement with the longitudinal direction of a barrier layer 32. Therefore, the heat generated from the barrier layer 32 of a chip 30 can be efficiently missed to a substrate 22 through the electrode pad 58.
[0089] Thus, the electrode pad 58 which arranged the forward hexagon annularly is used, and since the degree of freedom of the breadth range of a bump is restricted by each forward hexagon part, gap in the hand of cut between a chip and a substrate is canceled.
[0090] Moreover, according to this electrode pad 58, the whole pad area can be enlarged by combining two or more forward hexagons. As shown in drawing 14 , each honeycomb structure serves as a configuration which two forward hexagons arranged in the direction vertical to one piece and this connection direction in the connection direction of honeycomb structure. Therefore, since a bump's aspect ratio can be lowered and there is no part with a still larger area when this electrode pad 58 is used, height dispersion is also reduced. For this reason, precision dispersion of the direction of a flat surface and the height direction becomes small.

[Translation done.]

DESCRIPTION OF DRAWINGS

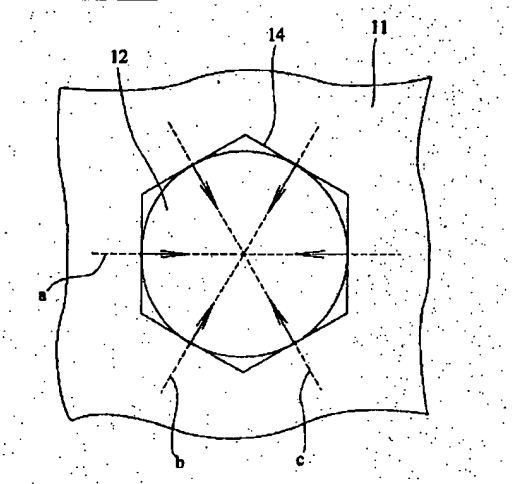
[Brief Description of the Drawings]
[Drawing 1] It is drawing with which explanation of the operation effectiveness of the optical module of the 1st invention is presented.
[Drawing 2] It is drawing with which explanation of the operation effectiveness of the optical module of the 2nd invention is presented.
[Drawing 3] It is drawing with which explanation of the operation effectiveness of the optical module of the 3rd invention is presented.
[Drawing 4] It is drawing with which explanation of the operation effectiveness of the optical module of the 4th invention is presented.
[Drawing 5] It is drawing showing the 1st configuration of the optical module of the gestalt of operation.
[Drawing 6] It is drawing showing the 2nd configuration of the optical module of the gestalt of operation.
[Drawing 7] It is drawing showing the 3rd configuration of the optical module of the gestalt of operation.
[Drawing 8] It is drawing showing the 4th configuration of the optical module of the gestalt of operation.
[Drawing 9] It is drawing showing the 5th configuration of the optical module of the gestalt of operation.
[Drawing 10] It is drawing showing the 6th configuration of the optical module of the gestalt of operation.
[Drawing 11] It is drawing showing the 7th configuration of the optical module of the gestalt of operation.
[Drawing 12] It is drawing showing the 8th configuration of the optical module of the gestalt of operation.
[Drawing 13] It is drawing showing the 9th configuration of the optical module of the gestalt of operation.
[Drawing 14] It is drawing showing the 10th configuration of the optical module of the gestalt of operation.

[Drawing 15] It is drawing with which explanation of a technical problem is presented.
[Description of Notations]
10, 14, 16, 18, 20, 26, 34, 36, 38, 40, 54, 56, 58: Electrode pad
11: A substrate or a chip
12 28: Spherical bump
22: Substrate
22a, 30a: Pad forming face
24: Wiring pattern
30: Chip
32: Barrier layer
42, 46, 50: Rectangle region
44a, 48a, 52a: The 1st electrode pad
44b, 48b, 52b: The 2nd electrode pad

[Translation done.]

DRAWINGS

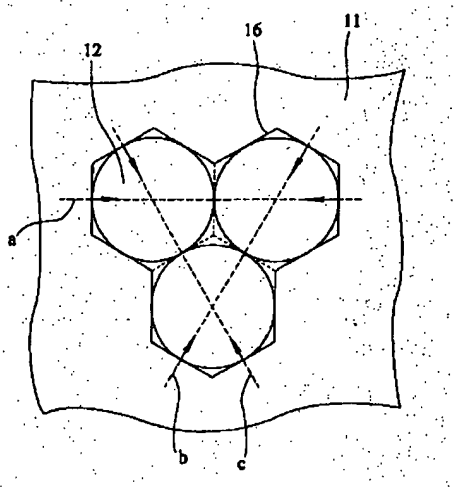
[Drawing 1]



11:基板またはチップ 12:球状バンプ 14:電極パッド

第1発明の作用効果の説明図

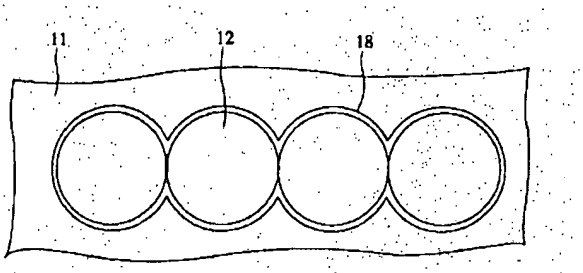
[Drawing 2]



16:電極パッド

第2発明の作用効果の説明図

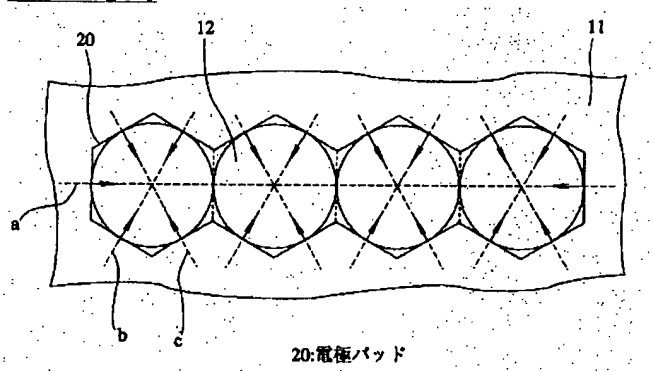
[Drawing 3]



18:電極パッド

第3発明の作用効果の説明図

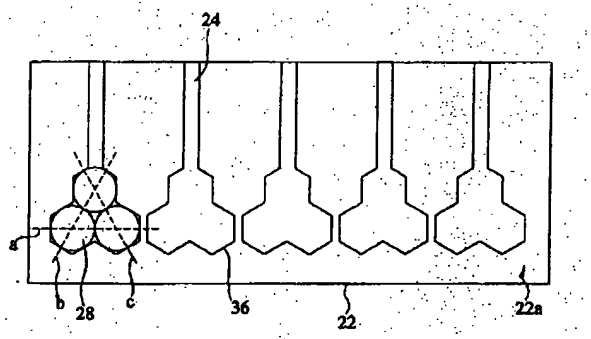
[Drawing 4]



20:電極パッド

第4発明の作用効果の説明図

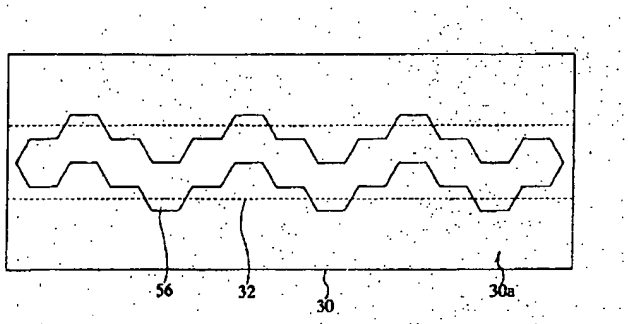
[Drawing 6]



36:電極パッド

第2の実施の形態の光モジュール

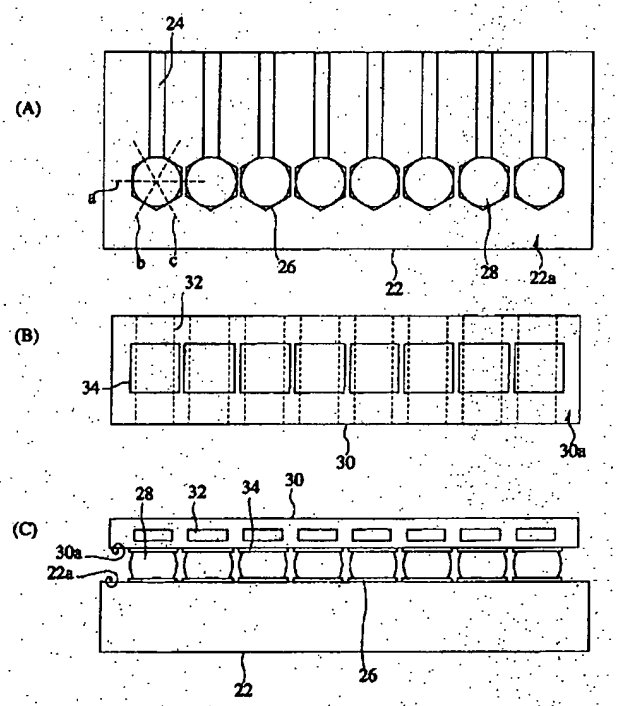
[Drawing 13]



56:電極パッド

第9の実施の形態の光モジュール

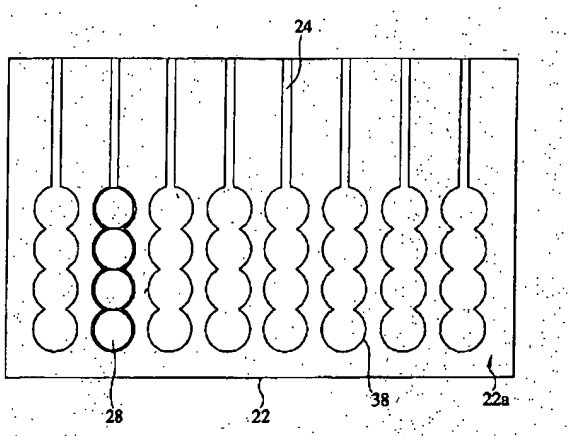
[Drawing 5]



22:基板 22a,30a:パッド形成面 24:配線パタン 26,34:電極パッド
28:球状バンプ 30:チップ 32:活性層

第1の実施の形態の光モジュール

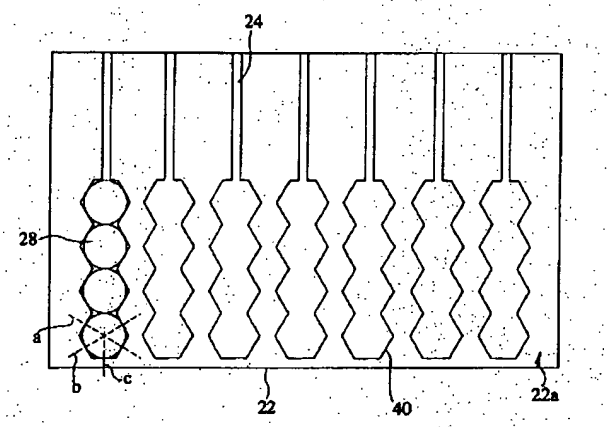
[Drawing 7]



38:電極パッド

第3の実施の形態の光モジュール

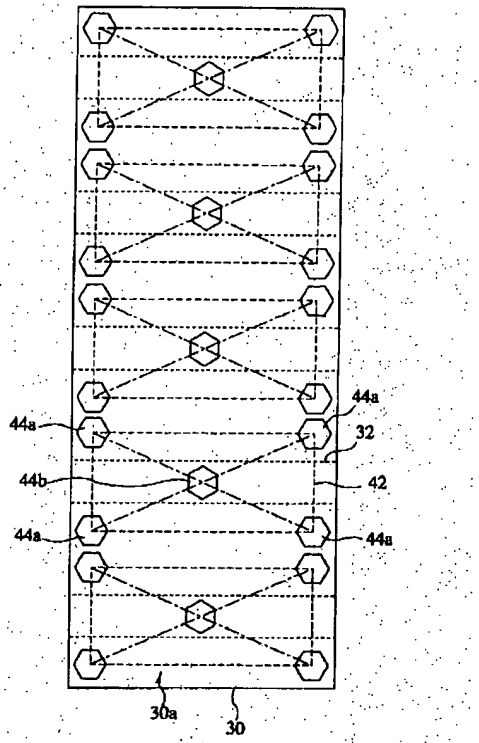
[Drawing 8]



40:電極パッド

第4の実施の形態の光モジュール

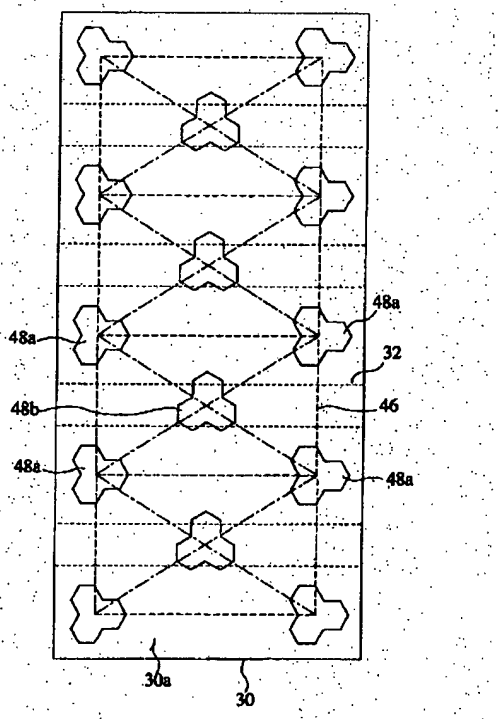
[Drawing 9]



42:長方形領域 44a:第1電極パッド 44b:第2電極パッド

第5の実施の形態の光モジュール

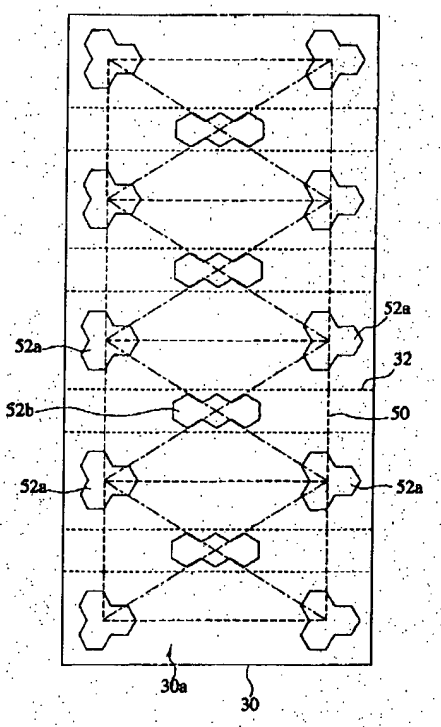
[Drawing 10]



46:長方形領域 48a:第1電極パッド 48b:第2電極パッド

第6の実施の形態の光モジュール

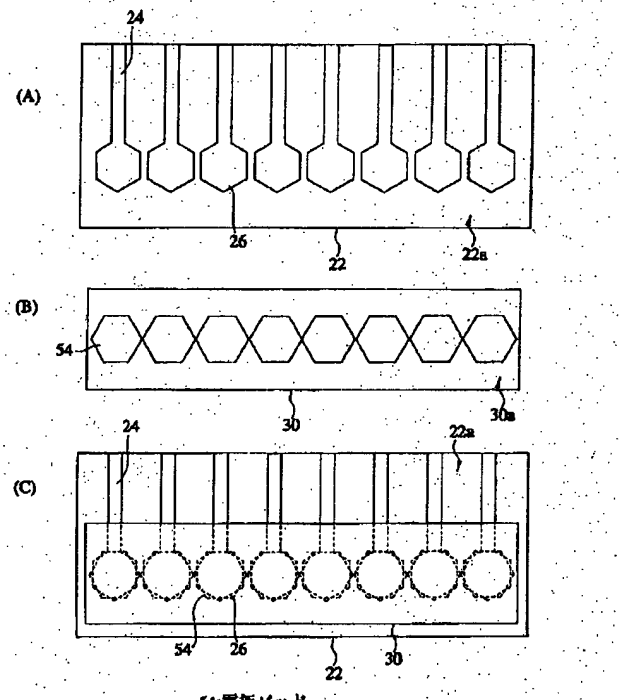
[Drawing 11]



50:長方形領域 52a:第1電極パッド 52b:第2電極パッド

第7の実施の形態の光モジュール

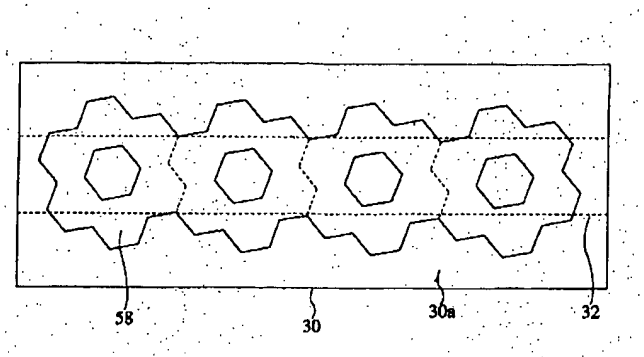
[Drawing 12]



54:電極パッド

第8の実施の形態の光モジュール

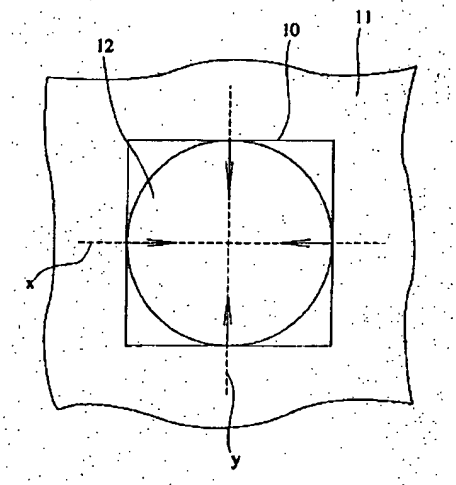
[Drawing 14]



58:電極パッド

第１０の実施の形態の光モジュール

[Drawing 15]



課題の説明に供する図

[Translation done.]